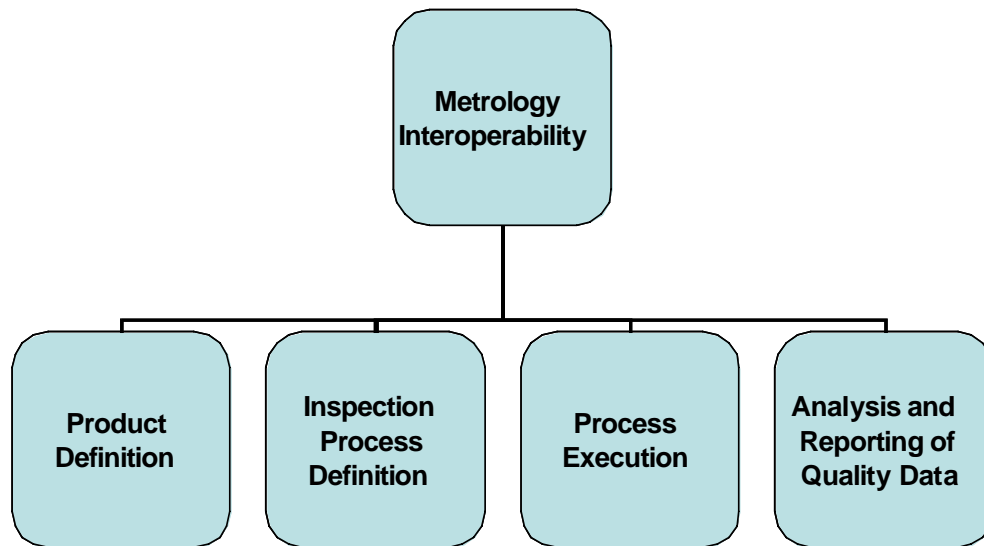


# INTERNATIONAL METROLOGY INTEROPERABILITY SUMMIT

## ANALYSIS AND REPORTING



---

## BREAKOUT SESSION

---

## GETTING STARTED

**Participants:**

Bob Stone  
Origin  
519-762-2177  
bstone@origin.com

Rich Knebel  
Zeiss  
248-486-7615  
rknebel@zeiss.com

Kim Summerhays  
MetroSage  
415-336-2244  
kdsummerhays@metrosage.com

Fredrick Wandebach  
IVF  
+46317066106  
Fredrik.wandebach@ivf.se

Per-Johan Wahlborg  
IVF  
+46317066107  
pen-johan@ivf.se

Joe Schafer  
UGS  
408-941-4673  
schaferj@usg.com

Bob Brown  
Mitutoyo  
630-723-3581  
robert.brown@mitutoyo.com

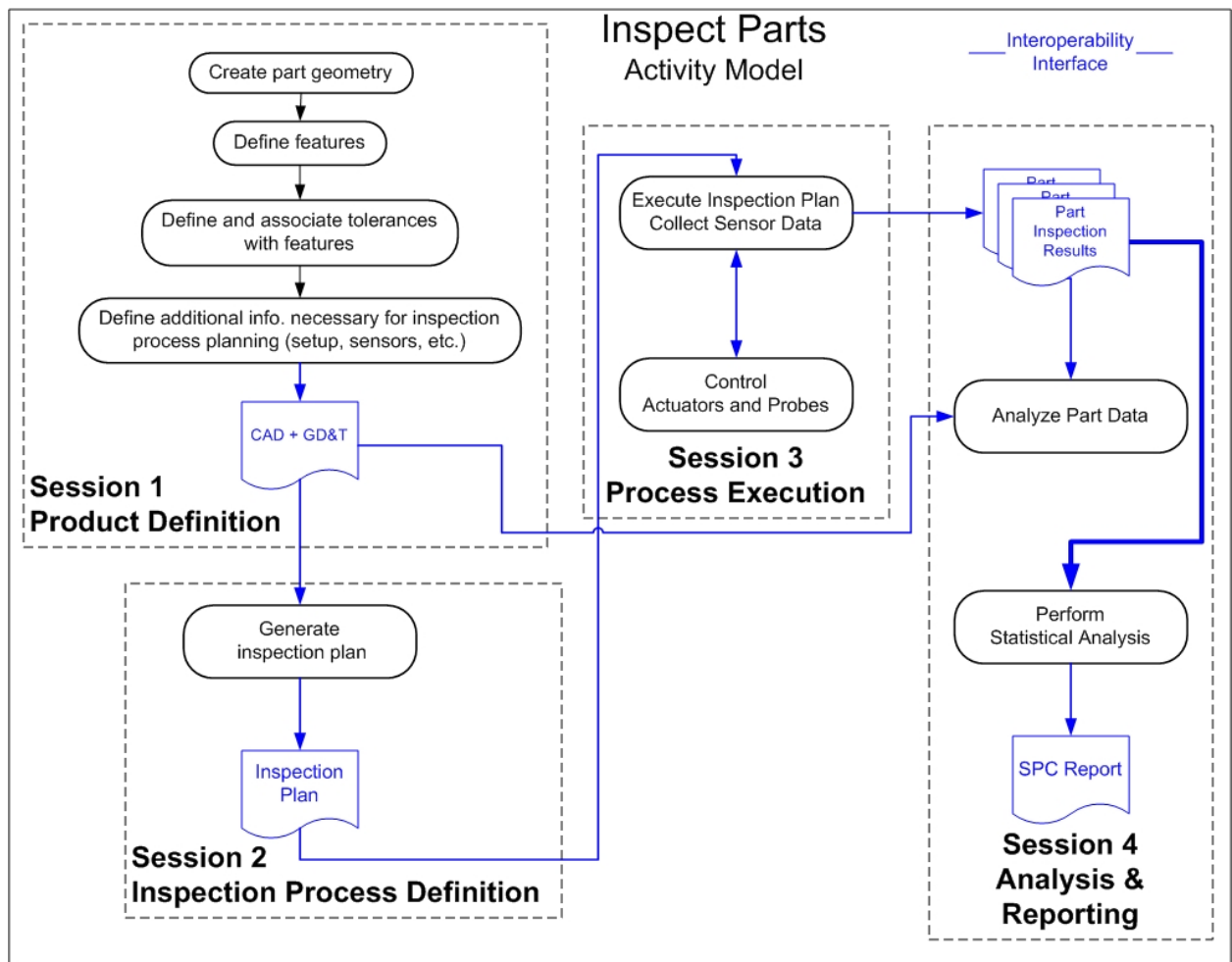
Alberto Griffa  
Geomagic  
919-534-0709  
agriffa@geomagic.com

Ted Vorburger  
NIST  
301-975-3493  
tvtv@nist.gov

Joe Falco  
NIST  
301-975-3455  
falco@nist.gov

## ACTIVITY DIAGRAM

1. Create an Activity Diagram for your topic area.



### Notes:

- Storage is also an issue
- Start diagram is vendor specific for standards effort needs to be neutral
- IP- Profit for producer
- Different outputs between products - precision, parameters, definitions, algorithms, algorithms, uncertainties, standard deviation. Ex. PPK, CPK Quality specs. – example Boeings AS 19000
- Use case/ flow of event examples are available AIAG perspective
- There should be a unification process as far as SPC
- Map process as it is from A to B. Steps from measure to report.

- Single measurement – integration of measurements (i.e., different physical locations) Is it a single part, multiple parts....
- Quality data must be complete
  - What production machine produced a bad feature (need birth certificate, traceability) to machine. The environment of the part as it is being manufactured.
  - Data Type 1-characteristics, 2-feature data, 3-row data, 4-data stream
- Data reduction without losing critical information
- Data analysis planning is important before the inspection process design. There is lots of info from design – tolerances but need more information on how to measure. No backflow of this information in the planning process
- Different data purposes: reverse engineering, process characterization, part qualification.
- Evolve inspection analysis and planning procedures with product and process development.
- DML Dimensional Data – Quality data must also include attributes such as conformance, non conformance (i.e., surface defects) data
- Need feedback to manufacturing process.
- Current state of DML
- Quality data standards are evolving now (i.e., QML)
- Optical data – how to describe
- Quality data must interface with business systems
- MES- Manufacturing Execution System & ERP –

2. From the activity diagram, define key functions that should be addressed:

Note: The draft activity diagrams define few key functions. If they are complete, that is fine, but be sure that all key functions in your topic area are identified. List the key functions here.

Generate Sensor Data

Traceability Data

Report to Business Systems

Perform Statistical Analysis

Measurement Planning

Evolve Manufacturing Process

## CURRENT STATE ASSESSMENT

---

### Definitions:

- **Deficiencies** – Activities where a lack of interoperability causes “pain”. Quantify the pain to the best level possible.
- **Barriers** – Obstacles that stand in the way of achieving interoperability – barriers to overcoming the deficiencies.
- **Emerging best practices** – What is being done today that is eliminating the “pain” and overcoming barriers? Try to capture as much content about the best practice as is possible,

## CURRENT STATE ASSESSMENT FOR ANALYSIS AND REPORTING

KEY FUNCTIONS	DEFICIENCIES – WHERE DOES IT HURT? HOW BADLY?	BARRIERS – WHAT’S IN THE WAY?	EMERGING BEST PRACTICES
Generate Sensor Data	<ul style="list-style-type: none"> <li>No attribute data</li> <li>Cannot handle large data sets - performance</li> <li>Non-uniform implementation of standards</li> <li>Lack of simplicity of standards</li> </ul>	<ul style="list-style-type: none"> <li>Multiple standards/specifications (i.e., AIMS, QS-stat ASCII, AP219, DMIS, DML, I++, ...)</li> </ul>	<ul style="list-style-type: none"> <li>DML</li> <li>DMIS</li> <li>AP219</li> </ul>
Report to Business Systems	<ul style="list-style-type: none"> <li>Interfacing quality data to business ERP</li> </ul>	<ul style="list-style-type: none"> <li>We don't understand what they need and they don't understand what they can get.</li> </ul>	<ul style="list-style-type: none"> <li>OAGI - Open Application Group</li> <li>UBL - Unified Business Language</li> </ul>
Measurement Planning	<ul style="list-style-type: none"> <li>Lack of knowledge about appropriate inspection technique (i.e., tolerances, algorithm sampling plan)</li> </ul>	<ul style="list-style-type: none"> <li></li> </ul>	<ul style="list-style-type: none"> <li>DITS – Dimensional Inspection Techniques Specification</li> <li>Automotive measurement practices (AP/QP)</li> <li>Mil Specs (Z1-3 ...)</li> </ul>
Traceability Data	<ul style="list-style-type: none"> <li>Non-uniform implementation of standards</li> <li>Insufficient links between traceability and inspection data</li> </ul>	<ul style="list-style-type: none"> <li>Multiple standards/specifications/practices</li> </ul>	<ul style="list-style-type: none"> <li>AIAG sub committee MEQM</li> <li>AP238 traceability component</li> <li>DMIS</li> </ul>
Perform Statistical Analysis	<ul style="list-style-type: none"> <li>Lack of statistical standardization</li> <li>Lack of knowledge</li> </ul>	<ul style="list-style-type: none"> <li>Multiple standards/specifications</li> <li>Not high on customers perceived list of priorities</li> </ul>	<ul style="list-style-type: none"> <li>ASQ</li> <li>AIAG</li> <li>CNOMO</li> <li>GM</li> <li>Juran/Demming</li> <li>ISO 14025 (QS 9000)</li> <li>Boeing AS 9001</li> </ul>
Evolve Manufacturing Process	<ul style="list-style-type: none"> <li>No standard methodology for adjusting a process</li> <li>Unambiguously communicating process change</li> </ul>	<ul style="list-style-type: none"> <li>No standard machine controller interface</li> <li>Human link</li> </ul>	<ul style="list-style-type: none"> <li>Renishaw</li> <li>M&amp;G Codes</li> <li>AP238 (STEP NC)</li> <li>Gleasonworks Feedback Process (12 adjustments)</li> <li>B5-59</li> </ul>

## **VISION FOR ANALYSIS AND REPORTING**

### **1. What is the envisioned future state for Analysis and reporting?**

- A unified data model (integrated resources) with a common understanding of the definitions in the data model.
- Portability is a requirement.
- Accessibility to all data without duplication in an easy way (customer perspective)

### **2. Identify the attributes of a Vision for each of the key functions.**

#### **Characteristics of the Vision for “Generate Sensor Data”**

- Allow for the easy capture of data from any sensor
- Data has the same topology.
- Efficient data structure

#### **Characteristics of the Vision for “Report to Business Systems”**

- Automatic delivery of data to the semantics of a business systems

#### **Characteristics of the Vision for “Measurement Planning”**

- A educated work force
- Continuous improvement of the measurement process
- Automatic delivery of data to the semantics of a measurement planning system

#### **Characteristics of the Vision for “Traceability Data”**

- Traceability data is only entered once or captured automatically
- Common terminology
- Easy ad-hoc filtering

#### **Characteristics of the Vision for “Perform Statistical Analysis”**

- More visible role for uncertainty
- Uniform calculation methods with a reference to the calculation method used
- Intuitive results analysis with the ability to drill down

#### **Characteristics of the Vision for “Evolve Manufacturing Process”**

- Automatic and easy manual adjustments of manufacturing equipment
- Ensure that analysis and reporting standards efforts are coordinated with the standards efforts of manufacturing planning and execution

## ISSUES FOR ANALYSIS AND REPORTING

### Developing Issues:

An **Issue** is any technology void, cultural attribute, or process characteristic that impedes progress or is a barrier to the optimal successful execution of the subject function. Issues may be generic, or they may apply to specific products, processes, etc.:

- Product-Specific – Issues that deals with design or performance of the topic. Ask the question; are there issues associated with a product or class of product? Are there specific issues associated with any sector or application?
- Process-Specific – Issues that deals with execution of the topic. Are there processes or activities that lead to the identification of issues? For example, inspecting large structures with laser trackers might raise different issues than a touch probe for a CMM.
- Other – Standards, Emerging Technologies, Disruptive Technologies, Infrastructure. Are there issues that fall in the catch all categories? What margining technologies could greatly change the metrology landscape? What practices (like in process certification) present issues? What emerging technologies or practices would be implemented if cultures were changes or infrastructure was not an issue?

Evaluate the work that you have done in getting to this point, and tabulate the issues. Keep in mind that the Issues may or may not align with the Key Functions, but be sure that you do tabulate all issues associated with executing the key functions. Also, remember that there are crosscutting issues that someone must address. Tabulate them separately.

Use the space below to tabulate issues, and when complete, tabulate in the table on the next page. It may be necessary to group and screen issues. All important issues should be tabulated, but be sure to keep them at a high level – this is the top of the hierarchy (at the program level).



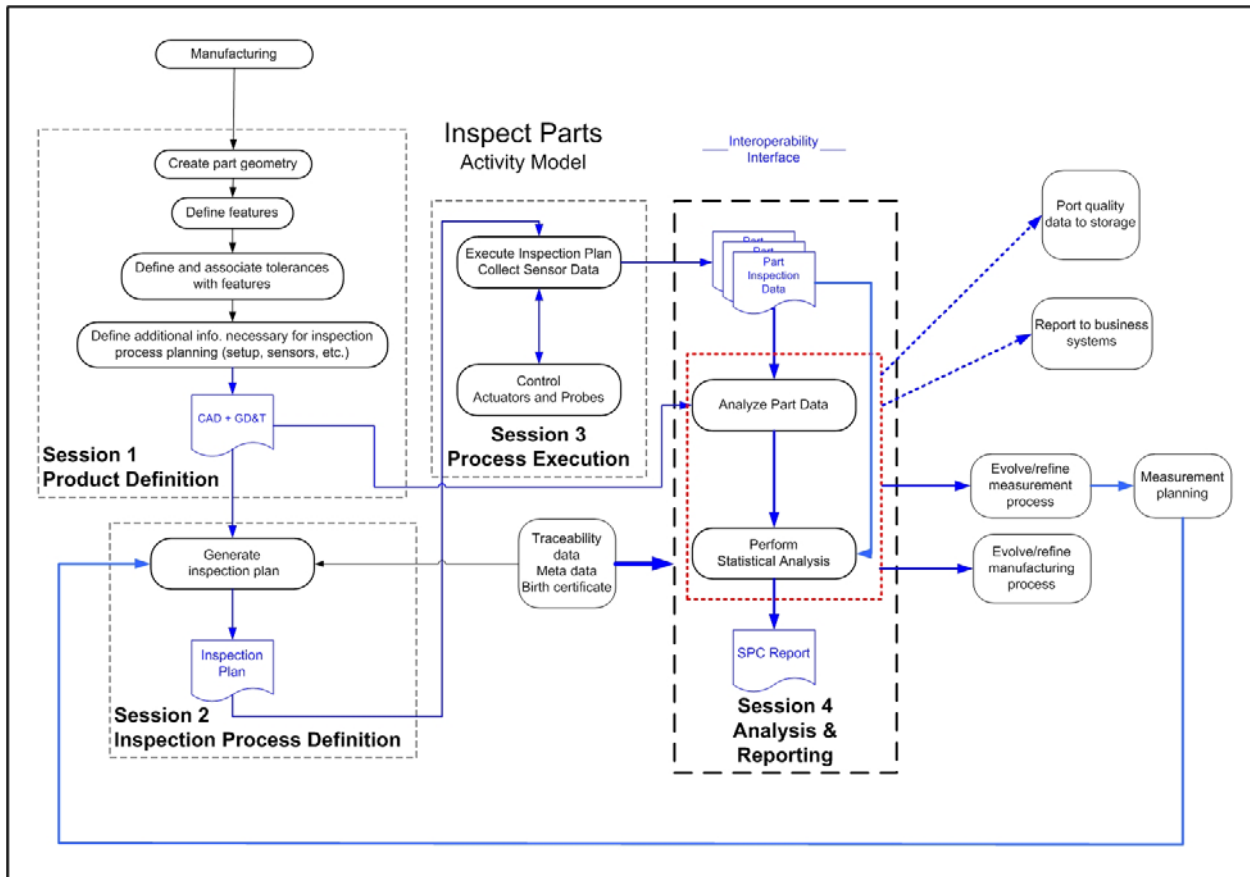


<b>TOP ISSUES</b>	
<b>Generate Sensor Data</b>	1. Bandwidth and storage limitations (data overload)
<b>Report to Business Systems</b>	1.
<b>Measurement Planning</b>	1. Feedback of study data 2. Planning for report formatting (standardization of report templates) 3.
<b>Traceability Data</b>	1. Investigate ASME B5.59
<b>Perform Statistical Analysis</b>	1. Uniform calculation methods and definitions
<b>Evolve Manufacturing Process</b>	1. Feedback of study data
<b>Cross Cutting Issues</b>	1. Legacy systems are too dumb and costly to update 2. Synchronization and correlation of all data for each measurement (primarily traceability) 3. Proprietary business models 4. Uniform data model for the single part report with provision for filtering to avoid performance issues 5. Uniform data model for quality study summary reports with traceability



## Update Activity Diagram

Copy the “as is” activity diagram and update it to reflect the vision and include, where applicable, the issues.



### Note:

It is not possible to gauge pace in a roadmapping exercise. It is also variable because the richness and breadth of the topic areas are not equivalent. If you are not at exactly the “right point” at the end of the day, don’t feel badly. We’ll catch up. Try to have the issues defined.

## **Preparation of the Presentation**

Transfer from this template to the Power Point template for Presentation 1, and gain group consensus on:

Your activity diagram

Key points from your current state assessment

Vision

Issues

Updated Activity Diagram ("To Be")

See presentation: "Analysis and Reporting.ppt"

## BUILDING THE ROADMAP

### DEFINING MAJOR ISSUES – SOLUTIONS AND ACTIONS

**YOU WILL NOT POPULATE THE ROADMAP IN PROCESS. THE MODEL IS SHOWN TO MAKE YOU AWARE OF THE FORM OF THE RESULT.**

Priority	WBS	Roadmap Hierarchy	Metric	FY2007	FY2008	FY2009	FY2010	FY2009
	1	Topic Area e.g. Analysis and reporting						
	1.1	Issue: Text						
Future Medium High	1.1.1	Solution: Text	Definition of Metric	Maturity Start	Action Benefit Cost	Maturity Final		
					Maturity Start	Action Benefit Cost	Maturity Final	
	1.1.2	Solution Text				Maturity Start	Action Benefit Cost	Maturity Final

A **solution** is a critical capability that must be achieved to solve an issue. Keep in mind that parallel paths are often the best methods for assuring resolution of technical challenges, as illustrated by the following example for fuel cells:

- **Example Solution 1: Reduce variety and strictness of fuel requirements.**
  - Task 1: Determine and issue standards for challenging but attainable baseline fuel specification for use by several major classes of powered devices.
  - Task 2: Retrofit existing devices (for given major class) to use baseline fuel within two years.
- **Example Solution 2: Provide compact and flexible fuel reformer for environmentally benign field use.**
  - Task 1: Provide advanced filtration and sulfur removal system.
  - Task 2: Eliminate/minimize water requirements from fuel reformation process.

i.

Priority:

List the Issue and then develop the solution. The facilitator will have to make a determination as to whether there is time to flesh out solutions and actions. If there is, it is usually better to do that in one-pass. If not, list the solutions and come back to the actions. It is preferable to complete the additional information for the solution set than to add actions and fail to complete.

**ISSUE 1: Bandwidth and storage limitations (data overload)**

**Solutions:**

- List Solutions Here
  - **Actions:**
    - List Here

**ISSUE 2:**

**Solutions:**

- List Solutions Here
  - **Actions:**
    - List Here

**ISSUE 3:**

**Solutions:**

- List Solutions Here
  - **Actions:**
    - List Here

**(SEE NEXT PAGE)**

## WORKING LIST:

### H 13

**Issue 1:** Bandwidth and storage limitations (data overload)-13

**Solutions:**

1. Handle large data and provide acceptable performance

**Actions:**

- Be rigorous in defining all use cases
- Develop timing diagrams and use threading
- Further optimization of data models
- Maximize throughput of data pipe (minimum and recommended hardware requirements)

**M 7 Issue2:** Lack of feedback of study data for manufacturing-7

**Solutions:**

1. Augment data model for feedback to manufacturing

**Actions:**

- Investigate existing manufacturing APs
- Develop data model for minimum requirements for traceability of a measured characteristic to an operation

**F Issue3:** Planning for report formatting (standardization of report templates)

**Solutions:**

**M 7 Issue4:** Lack of consistency of statistical calculation methods and definitions - 7

**Solutions:**

1. Capture and identify best practices and unify into a single standard

**Actions:**

- Identify existing standards and consolidate
- Provide a test suite (NIST)
- Work with NIST to provide a certification process

**M 7 Issue5:** Lack of feedback of study data for measurement planning - 7

**Solutions:**

1. Develop a methodology to change the measurement and sampling plan based on measurement results

**Actions:**

- Identify current best practices
- Assess impact of GM patent application
- Need academic involvement.
- Need a champion to carry the message (Crosby or Wheeler)

**F Issue6:** Legacy systems are too dumb and costly to update

**Solutions:**



**H 11 Issue7:** Synchronization and correlation of all data for each measurand (primarily traceability) -11

**Solutions:**

1. Augment data flow models to uniformly integrate data from different sources into single part and summary report data models

**F Issue8:** Proprietary business models

**Solutions:**

**H 17 Issue9:** Lack of uniform data model for the single part report. - 17

**Solutions:**

2. Provide unified data models for single part inspection measurement results

**Actions:**

- Investigate ASME B5.59
- Evaluate and choose between
  - i. Improve DML
  - ii. Improve DMO
  - iii. Improve STEP models
  - iv. Develop new data model from scratch

**H 13 Issue10:** Lack of uniform data model for quality study summary reports with traceability - 13

**Solutions:**

1. Develop unified data model

**Actions:**

- Investigate ASME B5.59
- Evaluate and choose between
  - i. Improve STEP models
  - ii. Realize AIAG MIPT MEQM data model

Improve and bring to the public domain QML

## THE ISSUE ASSESSMENT

Suggested timeframes:

- 0-3 years (short)
- 4-7 yrs (medium)
- 8-12 years (long)

**ISSUE X:** Name goes here

**SOLUTION X:** Name goes here

- **Priority (H/M/F):** Enter data here
- **Duration: How long will it take** – enter data here
- **Timeframe: when does it start?** Enter data here
- **Known Dependencies: what has to be done as a prerequisite or in parallel?** Enter data here
- **Metric: What is the achievement that will be realized?** Enter data here
- **ROM Estimate (\$): How much will it cost?** Enter data here
- **Benefit: What good thing will result and by how much? Provide any information useful for a business case**
- **Change to MRL (see chart in methodology handout) – don't try to be too analytical – a subjective evaluation is fine. Record starting and ending MRL.**
- **Organizational barriers and required changes**
- **Notes:** Enter data here

## Priority Solutions with Assessments (needs work)

For the closing presentations, select the most important solutions from your solutions list. The maximum is 10, so, if you have more than 10, you will need to group and prioritize. Insert priority solutions into the PowerPoint template provided

Note: All 10 issues/solutions were presented

### Group poll for priority rating:

Two hands up – High  
One hand up – Medium  
No Hands – Low

Note – Issues 8, 9, and 10 were not included in the vote. These issues were determined to be issues that would most likely to be addressed in the future and were not analyzed for solutions due to lack of time.

Final priorities of H, M, and F were based on a hand count of polls for each issue:

High – 11 hands and above  
Medium – 10 thru 8 hands  
Future – 7 hands and below

**Issue 1:** Lack of uniform data model for the single part report.

**Solutions:** Provide unified data models for single part inspection measurement results

#### **Actions:**

- Investigate ASME B5.59
- Evaluate and choose between
  - i. Improve DML
  - ii. Improve DMO
  - iii. Improve STEP models
  - iv. Develop new data model from scratch

**Priority: High** (17 votes)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 2:** Lack of uniform data model for quality study summary reports with traceability

**Solutions:** Develop unified data model

**Actions:**

- Investigate ASME B5.59
- Evaluate and choose between
  - i. Improve STEP models
  - ii. Realize AIAG MIPT MEQM data model
  - iii. Improve and bring to the public domain QML

**Priority: High** (*13 votes*)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 3:** Bandwidth and storage limitations (data overload)

**Solutions:** Handle large data and provide acceptable performance

**Actions:**

- Be rigorous in defining all use cases
- Develop timing diagrams and use threading
- Further optimization of data models
- Maximize throughput of data pipe (minimum and recommended hardware requirements)

**Priority: High** (*13 votes*)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 4:** Synchronization and correlation of all data for each measurand (primarily traceability)

**Solutions:** Augment data flow models to uniformly integrate data from different sources into single part and summary report data models

**Priority: High** (11 votes)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 5:** Lack of feedback of study data for manufacturing

**Solutions:** Augment data model for feedback to manufacturing

**Actions:**

- Investigate existing manufacturing APs
- Develop data model for minimum requirements for traceability of a measured characteristic to an operation

**Priority: Medium** (7 votes)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 6:** Lack of consistency of statistical calculation methods and definitions

**Solutions:** Capture and identify best practices and unify into a single standard

**Actions:**

- Identify existing standards and consolidate
- Provide a test suite (NIST)
- Work with NIST to provide a certification process

**Priority: Medium** (7 votes)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 7:** Lack of feedback of study data for measurement planning

**Solutions:** Develop a methodology to change the measurement and sampling plan based on measurement results

**Actions:**

- Identify current best practices
- Assess impact of GM patent application
- Need academic involvement.
- Need a champion to carry the message (Crosby or Wheeler)

**Priority: Medium** (7 votes)

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 8:** Planning for report formatting (standardization of report templates)

**Priority: Future** (not included in group poll)

**Solutions:**

**Actions:**

**Priority:**

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 9:** Legacy systems are too dumb and costly to update

**Priority: Future** (not included in group poll)

**Solutions:**

**Actions:**

**Priority:**

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**

**Issue 10:** Proprietary business models

**Priority:** Future *(not included in group poll)*

**Solutions:**

**Actions:**

**Priority:**

**Time Frame:**

**Known Dependencies:**

**Metric:**

**ROM Estimate (\$):**

**Benefit:**

**Change to MRL:**

**Organizational barriers and required changes:**

**Notes:**